A device having a power rotor (3) and a seal rotor (10) which have coincident center points. The power rotor (3) rotates in a plane which is perpendicular to that within which the seal rotor (10) rotates. The power rotor (3) has a rotor body (5) to which are attached a plurality of outwardly extending vanes (6). The seal rotor (10) has a rim gear (13) to which are attached a plurality of inwardly extending vanes (15). The power rotor vanes (6) and the seal rotor vanes (15) interdigitate upon rotation of the rotors to define two variable volume chambers (24, 25). The power rotor vanes (6) and the seal rotor vanes (15) are designed and constructed to insure a close mesh during such interdigitation and means are provided for adjusting the position of the power rotor vanes (6) relative to the seal rotor vanes (15) to insure proper interdigitation.
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DESCRIPTION

ROTARY POSITIVE DISPLACEMENT MECHANISM

Background of Invention

The present invention relates to motors and pumps. More particularly, it relates to positive displacement rotary-type motors and pumps, specifically those rotary motors which are driven by pressurized fluid.

Due to the drawbacks inherent in the linear, oscillating motion and internal combustion of conventional piston engines, considerable attention has been directed to the development of alternative engine and motor designs. To circumvent the oscillating, linear motion of the conventional piston engine, many engine and motor designs have incorporated rotary motion of the power producing element. Turbine and rotary engines utilize this principle. Those rotary and turbine engines which have utilized internal combustion have suffered from low efficiency, limited durability and inflated expense and still produce the dirty exhaust of the conventional piston engines. Those rotary and turbine designs which have utilized external combustion have proven too inefficient to be of widespread practical utility.

Summary of Invention

The present invention is directed to a device employing two rotors designed such that they rotate about intersecting axes and have coincident center points. These rotors are contained within intersecting chambers such that one rotor thereby provides a displacement function while the other provides a sealing function. The chambers and rotors cooperate to define two variable volume chambers which may be employed as either pumping chambers or fluid motor power chambers. In this way, a positive displacement mechanism has been developed which
employs balanced rotation. This efficient system lends itself to use as a source of motive power derived from the use of pressurized fluids, pressurized by external combustion or other means.

To accomplish positive displacement with pure rotary motion, the power rotor is positioned within the seal rotor, with both rotors rotatable about the same center point. The power rotor, however, rotates in a plane perpendicular to that in which the seal rotor rotates.

The power rotor comprises a rotor body which has a plurality of outwardly extending vanes, which vanes interdigitate during rotation with a similar number of vanes extending inwardly from the seal rotor, said seal rotor having a rim gear to which the inwardly extending vanes are attached. The vanes on each rotor are designed and constructed to mesh closely during such interdigitation. This interdigitation allows the seal rotor vanes to eliminate fluid backpressure against the trailing power rotor vane and makes possible the positive displacement of the power rotor through its rotary motion. Also provided in the motor are fluid inlet and outlet means, rotor timing and adjustment means and power transmission means.

Description of Figures

Figure 1 is a top view of the motor of the present invention enclosed within the housing block.

Figure 2 is a side view of the invention, taken in cross-section along line 2-2 in Figure 1, showing the positional relationship of the power rotor and the seal rotor.

Figure 3 is a bottom view of the invention, taken in cross-section along line 3-3 of Figure 2, showing the positional relationship of the power rotor and the seal rotor.

Figure 4 is a side view of the invention, taken along line 4-4 in Figure 2, again showing the interrelationship of the power and seal rotors. Also depicted here are the
inlet and exhaust means, as well as the power transmission means.

Figure 5 is a perspective view of the power rotor in isolation.

Figure 6 is a perspective view of the seal rotor in isolation.

Figure 7 is a perspective view showing the relationship of the power rotor and the seal rotor, as well as the power transmission and timing means, all in isolation.

Figure 8 is a side view of the invention, with a portion broken away to show the inlet and exhaust means in relation to the power and seal rotors.

Detailed Description of Preferred Embodiment

The positive displacement device of the present invention is encased in a substantially solid, square housing block 1, which in the preferred embodiment has been formed in four pieces for ease of assemblage. The four pieces of the housing block are held together by conventional nut and bolt means 2.

Turning to the interior of the device, as shown in Figure 2, power rotor 3 is rotatably journaled within a first cylindrical chamber 4. Power rotor 3 is best seen in Figure 5. Power rotor 3 has rotor body 5 which is circular and solid. Power rotor vanes 6 extend outwardly from the rotor body 5. The vanes 6 are substantially triangular in shape and are attached to the rotor body 5 at the apex of that triangle. The leading and trailing edge of the vanes 6 are provided with a knife edge. Also attached to the rotor body 5 is spur gear 7. The function of spur gear 7 is explained infra. Extending through the center and protruding either side of power rotor 3 and spur gear 7 is axle 8 used to rotatably journal power rotor 3 within first chamber 4 by conventional journal means 9, as best seen in Figure 3.

Seal rotor 10 is disposed within second chamber 11, as best seen in Figures 3 and 4. Second chamber 11 is
-4-
cylindrical except for its center portion 11(a), which
contains the mounting means for the power rotor 3. Seal
rotor 10 is freely rotatable within second chamber 11 upon
thrust bearings 12. Both power rotor 3 and seal rotor 10
rotate about the same center point, but their planes of
rotation are perpendicular as can best be seen in Figure
4.

Seal rotor 10 consists of rim gear 13 having helical
gear teeth 14 about its total periphery. Seal rotor vanes
15 are fixably attached to the interior of rim gear 13 and
extend inwardly towards the center of seal rotor 10. The
seal rotor vanes 15 occupy nearly the entire interior
space of seal rotor 10, leaving only a central, circular
void space 16 and two outer spaces 17. Central circular
void space 16 is sufficiently large to allow the rotor
body 5 to rotate therein. Outer spaces 17 are suffi-
ciently large to allow power rotor vanes 6 to pass freely
therethrough. The outer spaces 17 defined by seal rotor
vanes 15 are broadly hyperbolic in shape as the leading
and trailing edges of seal rotor vanes 15 are convexly
arcuate. This is to allow snug meshing during interdigi-
tation of power rotor vanes 6 with seal rotor vanes
15 as power rotor 3 and seal rotor 10 are rotated.

Power rotor 3 is caused to rotate by introduction of
fluid into first chamber 4. As best seen in Figure 8,
seal rotor 10 substantially divides chamber 4 into an
upper half 24 and a lower half 25. Therefore, two sets of
inlet and exhaust means are required. Inlet tubes 18 and
19 extend from the exterior of housing block 1 to chamber
4. The first pair of inlet ports 18 inject fluid into the
upper chamber 24 in close proximity to rotor 10 at charge
ports 20. Exhaust ports 21, positioned near seal rotor
10, and exhaust tubes 22 provide the means by which the
fluid is removed from upper chamber 24. Second inlet
tubes 19, second inlet ports 26, second exhaust ports 23
and second exhaust tubes 27 provide the same function for
lower chamber 25. Notice that second inlet ports 26 and
second exhaust ports 23 are positioned near seal rotor 10 in the same rotational order as first inlet ports 20 and first exhaust ports 21. The need for this arrangement will become apparent when the operation of the motor is discussed infra.

The rotational motion of power rotor 3 is transmitted to drive shaft 30 by a series of gears. Spur gear 7, which is fixably attached to power rotor 3 engages first idler gear 31 which in turn engages second idler gear 32, both idler gears being journaled within block 1 by conventional means. Second idler gear 32 engages drive shaft gear 33 which is fixably attached to drive shaft 30.

The rotation of drive shaft 30 is used to time the rotation of seal rotor 10. Timing flange 34 is fixably attached to drive shaft 30 by conventional means, such as a set screw. Timing flange 34 is attached to flywheel gear 35 by conventional bolt means 36 which extend through elongated holes 37 to engage flywheel gear 35. The elongated holes 37 allow the position of timing flange 34 to be adjusted relative to flywheel 35. Flywheel gear 35 engages transmission gear 38 which is connected by transmission shaft 39 to helical gear 40. Transmission shaft 39 is journaled and attached to block 1 by conventional means. Helical gear 40 engages rim gear 13 of seal rotor 10. By this system of gears, leading from spur gear 7 to idler gears 31 and 32, to drive shaft gear 33, to flywheel gear 35, to transmission gear 38 and, via transmission shaft 39, to helical gear 40, the rotational movement of the power rotor 3 is directly imparted to seal rotor 10.

The position of seal rotor 10 relative to the position of power rotor 3 may be adjusted, to insure proper interdigitation of power rotor vanes 6 with outer spaces 17, by adjusting the position of timing flange 34 relative to flywheel gear 35.

In operation, fluid is injected into chamber 4 via inlet tubes 18 and 19. This causes power rotor 3 to rotate in a clockwise position, as shown in Figures 2 and
8. As the rotor vanes 6 pass through outer spaces 17 of seal rotor 10, each vane 6 interdigitating with a seal vane 15, seal rotor vanes 15 bisect chamber 4 into upper half 24 and lower half 25. This sealing of chamber 4 into upper and lower halves, each half containing one power rotor vane 6, reduces the presence of substantial back-pressure against the leading edge of each vane 6 as it rotates through a half revolution. As chamber 4 is sized to eliminate, as much as possible, all free space about power rotor vanes 6, rotor vanes 6 are positively displaced by the incoming fluid. As the power vanes 6 pass the exhaust ports 21 and 23, the fluid is allowed to escape. The vanes 6 again interdigitate with the seal vanes 15 to allow the vanes 6 to move from lower chamber 25 to upper chamber 24 and from upper chamber 24 to lower chamber 25, respectively. Once the vanes 6 have moved into the next chamber, seal vanes 15 again bisect chamber 4 into the respective upper and lower portions 24 and 25, and the cycle is repeated. This interdigititation, whereby power rotor vanes 6 are timed to pass through outer void spaces 17 formed between seal rotor vanes 15, is made to occur with substantial meshing of power rotor vanes 6 with seal rotor vanes 15 by properly adjusting the position of rotor vanes 6 to the position of seal vanes 15, and by designing and constructing the leading edge 42 of seal vanes 15 to be slightly arcuate to correspond to the position of the rotor vanes 6 as it passes through outer space 17. The trailing edge of each seal vane 15 is arcuate to correspond to the position of power vanes 6 when the power rotor 3 is rotated in the reverse, counterclockwise direction. The shape of the leading and trailing edges of successive seal vanes 15 causes outer spaces 17 to be broadly hyperbolic in shape. This shape allows for close meshing of power vanes 6 with seal vanes 15 thereby providing for more efficient reduction of fluid backpressure.
Thus an improved rotary positive displacement mechanism has been disclosed. While embodiments and application for this invention have been shown and described, it would be apparent to those skilled in the art that many more modifications and embodiments are possible without departing from the inventive concepts herein described. It will be particularly noted that the device here disclosed can be designed and constructed to function as a pump as well as a motor. The invention, therefore, is not to be restricted except by the spirit of the appended claims.
Claims:
1. A rotary positive displacement device having a housing; a first cylindrical chamber and a second cylindrical chamber in said housing; a first rotor and a second rotor rotatable within said first and second chambers, respectively, each said rotor being rotatable about the same center point, said first rotor rotating in a plane which is substantially perpendicular to the plane in which said second rotor rotates; said rotor designed and constructed for close, meshing interdigitiation during rotation; and means for causing one said rotor to rotate within its said cylindrical chamber.

2. The invention of Claim 1 wherein said first rotor comprises a rotor body with a plurality of vanes extending outwardly therefrom, and said second rotor comprises the rim gear with a plurality of vanes extending inwardly therefrom.

3. The invention of Claim 2 wherein each said rotor vane has a leading and a trailing edge, each said edge being arcuate in shape to substantially continuously mesh with said vanes on said other rotor during interdigitation therewith.

4. The invention of Claim 3 wherein said second rotor vanes define a void space between them, said void space comprising a center circular space and a plurality of outer spaces, said center space being of sufficient diameter to allow said first said rotor body to rotate therein; and said outer spaces being of sufficient size to allow said first rotor vanes to pass therethrough; said outer spaces being broadly hyperbolic in shape; and each said first rotor vane being broadly triangular in shape such that there is substantial continuous meshing.
between corresponding said first and said second rotor vanes during interdigititation.
# INTERNATIONAL SEARCH REPORT

**International Application No.** PCT/US83/00993

## I. CLASSIFICATION OF SUBJECT MATTER

According to International Patent Classification (IPC) or to both National Classification and IPC

- **INT. Cl.** 9 F01C 3/02
- **U.S. Cl.** 418/195, 418/207

## II. FIELDS SEARCHED

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Documentation Searched other than Minimum Documentation
to the Extent that such Documents are Included in the Fields Searched.

## III. DOCUMENTS CONSIDERED TO BE RELEVANT

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**“A”** document member of the same patent family

## IV. CERTIFICATION

- **Date of the Actual Completion of the International Search**: 10 August 1983
- **Date of Mailing of this International Search Report**: 26 AUG 1983

**International Searching Authority**

**ISA/US**

**Signature of Authorized Officer**

John J. Vrablek: mlc

Form PCT/ISA/210 (second sheet) (October 1981)